VIRGINIA GIS REFERENCE BOOK

General Application Name: County Executive & Board of Supervisors

Product / Service / Function Name: County Asset Inventory

P/S/F Description:

A county asset inventory involves managing and tracking all County assets including, but not limited to, transportation and utility infrastructure, recreational properties, and social facilities. With the implementation of the Governmental Accounting Standards Board Statements Number 34: Basic Financial Statements – and Management Discussion and Analysis – for State and Local Government (GASB 34), public agencies that receive federal funding, including county government, are charged with reporting the values and condition of all their physical assets and infrastructure. Organizations must either calculate the historic cost of each asset minus its depreciation through time, or develop an infrastructure asset inventory and management system that will generate an accurate inventory of all assets, report the condition of assets every three years, and determine the annual estimate of the cost needed to maintain the asset in its current conditions. GIS technology is an ideal medium for accessing, maintaining, tracking, analyzing, and reporting this information. Resulting benefits of implementing a county asset inventory and management system include improving financial reporting, enhancing awareness of fiscal issues, identifying infrastructure needs, and maintaining citizen confidence in city stewardship of public assets.

Product / Service / Function

1. Spatial Data:

Minimum Data Requirements

General Description	Data Layer
Transportation	Street Centerlines
	Bridges
Socio-Political Data	Municipal Boundary
	Police Stations
	Fire Stations
	Schools
	Park and Recreational Facilities
Land Base / Planimetric Data	Tax Parcels
Utilities	Water Mains
	Sanitary Sewer Mains
	Water Features (reducers, valves, hydrants)
	Sanitary Sewer Features (manholes, pumping stations)

Optional Data Requirements

General Description	Data Layer
Transportation	Street Signs
	Tunnels
	Guardrails

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	Traffic Lights
Socio-Political Data	Libraries
	Prisons
	Commuter resource locations (Park and ride lots, public transportation facilitates)
	Animal Shelters
	Bike Paths
	Nature Centers
	Public Pools
	Wheel Chair Ramps
Land Base / Planimetric Data	Building Footprints (county buildings)
	Street Lights
	Curbs
	Sidewalks
	Medians
Utilities	Storm Water Systems
	Storm Water System Features (culverts, inlets)
	Utility Poles
Other Data	Digital Orthophotography
	Video Logs
	Photos

2. Attribute Data:

Minimum Attribute Requirements

General Description	**Field Name**
Roads	Unique Identification Number
	Road Type
	Installation Date/ Year Built
	Functional Class
	Inspection Date
	Surface Condition
Signs	Unique Identification Number
	Sign Type
	Installation Date
	Sign Condition
Socio-Political Facilities	Unique Identification Number
	Facility Type
	Inspection Date
	Condition
	Address
Utilities	Unique Identification Number
	Type
	Material Type
	Installation Date/ Year Built Date
	Condition

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	Size/Diameter
	Length

Optional Attribute Requirements

General Description	Field Name
Roads	Shoulder Type
	Curb Type
	Maintenance
	Work Order Number
	Labor cost
	Equipment cost
	Material cost
	Inspector
Signs	Maintenance
	Work Order Number
	Labor cost
	Equipment cost
	Material cost
Socio-Political Facilities	Inspector
	Work Order Number
	Labor cost
	Equipment cost
	Material cost
	Maintenance
Utilities	Maintenance
	Work Order Number
	Test Results (Dye Test, Smoke Test, Hydrant Flow Test, Water Meter Test)
	Labor cost
	Equipment cost
	Maintenance cost

3. Data Acquisition Options

There are many sources for the spatial and attribute data that a county asset inventory system requires. There are five types of GIS data acquisition for assets including 1) creating data from existing sources, 2) the collection of data directly from the field, 3) geocoding structures, 4) acquiring existing data from other agencies and organizations, and 5) integrating information from other county systems. The data collection method chosen will depend on the desired level of accuracy, availability, quality, time frame, and budget.

County agencies have several sources of information that can be converted into digital GIS-compatible format. Hardcopy as-built drawings, blue prints, maps, plats, and other documents can be scanned, registered to a coordinate system, and digitized. Feature attributes can also be collected from the various hardcopy sources. Annotation on paper can be added to the feature's database during the digitization process. Some as-built drawings may already be in digital

format, maintained as CADD files. With some processing and manipulation, these files can be converted into seamless GIS data layers.

Spatial data can also be created directly from the VBMP orthophotography. Features visible on the image can be digitized/traced to generate vector (point/line/polygon) map layers. Attributes can be entered throughout the digitization process. Features that are not clearly visible on the image should be captured through another method, such as GPS (Global Positioning System).

Scanning photos of the assets or taking digital photos is another popular way of recording visual information. Photos become increasingly necessary to asset inventory that may be damaged or destroyed and later replaced with an identical item.

As an alternative to using existing information sources, GPS can be used to collect spatially accurate data directly from the field. The visual inspection of features is an advantage in collecting information for an asset inventory though GPS. With a defined data dictionary, field workers can record detailed attribute data simultaneously with the collection of a feature's location information. For example, while collecting street sign points, users can enter attribute information such as the sign condition, from menus on the GPS receiver. Recorded choices could be as simple as a range from poor to excellent, or could be specific such as poor reflectivity, replacement necessary, realignment necessary or no problems.

Street centerline data layers of varying qualities can be obtained by a number of vendors. The market is relatively competitive, and prices will vary with quality of the data. Relevant vendors that provide this kind of spatial data on a regional and national scale include: NAVTECH (www.navtech.com), GDT (www.geographic.com), and TeleAtlas (www.teleatlas.com).

Current systems within the county may already work with inventory data such as a pavement management system, bridge management system, accounting/financial system, or SCADA (Supervisory Control and Data Acquisition) system. Data from these sources could be migrated and integrated with the asset inventory system.

4. Data Conflation Options

Data conflation is a process by which two digital data layers, usually of the same area at different points in time, or two different data layers of the same area, are geographically "corrected" through geometrical and rotational transformations so that the different layers can be overlaid on one another. Also called "rubber-sheeting," this process allows a technician to adjust the coordinates of all features on a data layer to provide a more accurate match between known locations and a few data points within the base data set. A good base layer to use for data conflation is the VBMP orthophotos since many features can be seen or interpreted. The need and processes for conflation varies between sets of data, users, and feature types. Any dataset that is updated independently by different departments can be consolidated through conflation. Within most local governments, individual departments are responsible for maintaining specific datasets within their expertise; therefore, conflation is not often necessary. Often, reprojecting the data into a different coordinate system will take care of the misalignment of different data sets. Most industry-standard GIS software has the ability to perform data conflation.

Each data layer used for asset inventory application should use the Virginia Base Mapping Project orthophotography as the reference data for the conflation process. Since county asset inventory data comes from a wide variety of sources, it is imperative that the projections and coordinate systems are the same for all data layers.

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5. GUI / Programming Options:

There are many options for developers of a GIS-based county asset inventory system. The following are three avenues:

- Standard GIS desktop application that can be customized to the user's needs
- Existing commercial county asset inventory system
- Hiring a consultant to develop a custom system from scratch.

Using a standard GIS application often requires a significant amount of training and customization. Whereas the initial cost may be lower, the time invested in learning these solutions may generally increase the overall expense of implementation. However, standard GIS packages deliver more robust data integration, analysis, and cartographic capabilities than do other specialized commercial applications. They have a greater user support infrastructure that allows users to overcome problems quickly.

Standard GIS Software Vendors:

Vendor	**Software**	**Web Address**
ESRI	ArcView 3.x	www.esri.com
ESRI	ArcGIS 8.x	www.esri.com
MapInfo	Professional 7.0	www.mapinfo.com
Intergraph	GeoMedia 5.0	www.intergraph.com/gis
Autodesk	Map 5.0	www.autodesk.com

With the arrival of GASB 34, there has been an increasing number of vendors developing and implementing asset inventory software. Some software solutions focus on only one aspect of asset inventory, developing separate modules (e.g., transportation assets, utility assets) for various county departments. These products may often cost more than standard GIS packages because of the customization that is required to fit the application into the agency's business practices and/or connect to existing databases. The advantage is that a tailored asset inventory application provides just the functionality that is needed, decreasing the overall application overhead common to industry-standard GIS software. Options for using an existing, commercial county asset inventory system include those listed in the following table:

Vendor	**Software**	**Web Address**
RPT Inc. & GeoDecisions	GeoPlan	www.rpt.com
Azteca Systems	CityView – Asset Management Module	www.azteca.com
IMS (Infrastructure Management Services)	ROWMan	www.ims-terracon.com/
CarteGraph	Several modules	www.cartegraph.com/
Hansen	Hansen 7.5	www.hansen.com

The final option for developing and implementing a county asset inventory system is to contract with a consultant. This option makes certain that a product will fulfill an agency's requirements. Unlike the first option, which requires the county to modify its own process/technology to fit the system, the system fits existing business practices. A consultant will be able to develop an

application that works with the wide range of systems that currently exist. Also, training and follow-up user support is often provided at a much more substantial level than with other options.

Ideally, a county asset inventory application would integrate operations and inventory data with GIS mapping and document management. The application should be designed in close collaboration with planning, public works, engineering, and administrative personnel. An infrastructure accounting module can be integrated with the basic asset inventory to display a chart of accounts, track capital projects, track maintenance or inspections, and estimate asset valuation (e.g., current and historic costs, depreciation values). An asset inventory application can help users inventory and manage elements and activities in road and utility networks as well. The application should automate operations, leading to efficient manpower utilization, effective use of funding and better decision-making.

6. Internet Functionality and Options:

The Internet has proven itself as a viable solution for local governments to centralize the maintenance and management of services and data. As more local governments are implementing Web-based solutions, they are finding that the Internet requires them to change the nature of an application or its usefulness. Through the flexibility of an Internet solution, software can be easily updated, and users gain greater accessibility to the applications and information they need for their specific tasks through simple, user-friendly interfaces.

If a local government so chooses, they can deploy a Web GIS application to allow citizens of their community to view maps of the county assets online. A typical online GIS application allows users to pan, zoom, and identify features. More advanced tools would allow site visitors to query the data layers, such as the age of roads or the closest elementary school, to create customized reports for download. GIS software vendors have products that can be customized in-house or by a consultant to provide Web GIS applications on the Internet, over an intranet or via wireless network.

GIS Internet Solutions

Vendor	Internet Software	Web Address
ESRI	ArcIMS	www.esri.com/software/arcims
MapInfo	MapXtreme	www.mapinfo.com
Intergraph	GeoMedia WebMap	www.intergraph.com/gis/gmwm
Autodesk	MapGuide	www.autodesk.com

7. Technical Requirements:

Minimum Technical Requirements
At its most basic level, a county asset management system can be used on a single, stand-alone workstation. This workstation would have a hard drive that stores all of the spatial data layers, as well as the GIS software package or application itself. A typical workstation running off-the-shelf software should have the following minimum specifications:

Processor: Pentium 3, 450 MHz
RAM: 128MB SDRAM at 133MHz
Hard Disk: 20GB (min.)

Monitor 1:	19"
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional
Printer:	8x11 office-grade color printer

Optimum Technical Requirements:
A more complex county asset inventory system may require multiple components, including servers, desktop workstations, ruggedized laptops, and/or handheld devices. For either a client-server or a Web-based application, the system should rely on a fairly robust server computer and high-end workstations. Example specifications of the necessary equipment are listed below:

Server

Processor:	Min. 2x Processors, 1.7 GHz, 512K cache
RAM:	Min. 2x 512MB RIMMS
Hard Disk:	Min. 2x 80GB +RAID
Monitor 1:	19"
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD drive
Modem:	56K
Network Card:	10/100 mbps

Workstation

Processor:	Pentium 4, 1.5 GHz
RAM:	512MB SDRAM at 133MHz
Hard Disk:	20GB (min.)
Monitor 1:	19”
Monitor 2:	17”
Floppy Drive:	3.5”
CD-ROM:	12x/8x/32x CD-RW drive
Modem:	56K
Network Card:	10/100 mbps
OS:	Windows 2000/NT/XP
Office:	Windows 2000 Professional

Other Components

Printer:	8x11 office-grade color printer and 8x11 production b/w printer
Plotter:	HP DesignJet 1055CM
Tape Backup:	Tape Library Server
UPS:	APC 1400 (or other similar)
Scanner:	11x17
Handheld:	Compaq IPAQ
Network:	T1

GPS Equipment: Receiver, Antenna, Data Processing software (various vendors)

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8. Administrative/Management Requirements

At the beginning of the project the assigned project manager of the county asset inventory system should consider completing some, if not all of the following tasks that relate to the administrative requirements of an asset inventory project:

- Determine, with or without the assistance of a consultant hired to develop the system, the preliminary vision and goals of the project.
- Determine the stakeholders (e.g. Board of Supervisors, planning department, public works department, local environmental agencies, school board, engineering department, etc.) of a county asset management project within their own jurisdiction and with larger government entities that they interact with.
- Coordinate an initial stakeholders meeting where the vision and goals of the project are expressed and the background of GIS technology is described, if needed.
- Coordinate with other government agencies for data sharing provisions.
- Determine a mechanism of communication to keep the stakeholders aware of the progress of the project.
- Develop a basic understanding of the available precedents in their region/state and research the available technologies that can be applied to their project.

Upon project completion, a simple desktop county asset inventory application will require very little administrative support. Administrative tasks may include loading or upgrading new versions of the software or patches, providing for constant data flow from the other systems, and maintaining yearly support contracts on the hardware and software. However, once the system becomes widely distributed, there are various other management requirements that need to be fulfilled on a weekly or monthly basis.

At the point where the system grows beyond single desktop users, a devoted administrator or system manager needs to be established. This is essential for the following reasons:

- The system will now be interfacing with other technology systems already in place,. Therefore, someone needs to maintain contact with the technology personnel that maintain these systems.
- The manager needs to put into place quarterly training schedules to maintain user knowledge of the system.
- Funding will undoubtedly be required to either maintain the system long-term, or continue to expand the system, which requires funding research and applications for grants.

9. Costs:

Hardware	**Typical Unit Cost**
Minimum Workstation	$2,000
Optimum Workstation	$3,200
Laptop	$2,400
Web/FTP Server	$8,500
Database Server	$12,000
Data Warehouse Server	$18,000
Backup Server	$5,800
Printer (8x11 color)	$700

Printer (8x11 b/w production)	$2,000
Plotter	$12,000
Tape Library	$5,000
UPS	$700
Scanner	$1,500
Handheld	$300-$700
GPS Equipment	$4,000 - $12,000

Software (all prices included license)	**Typical Unit Cost**
Standard desktop software	$700-$10,000
Vendor asset inventory application	$10,000-$30,000
Customized vendor solution	$30,000-$50,000
Web-based vendor application	$15,000-$35,000
Customized web-based vendor solution	$35,000-$60,000

Miscellaneous	**Typical Unit Cost**
Training – focused vendor asset inventory (per person)	$1,00-$5,000
Training – general GIS	$700-$1,200
Licensing – desktop	$300-$1,500
Licensing – web app (1st CPU)	$7,500-$12,000
Maintenance (per year)	$8,000-$15,000

10. Standards / Guidelines Summary

- Always maintain a unique identification number with every spatial feature, and event recorded within the system so that the many different county asset data layers can be integrated together in one application without creating confusion.
- Standardize naming conventions for data sets, feature names, and codes.
- Standardize street naming conventions to make certain of proper geocoding then standardize additional fields, such as borough name or zip code, that are collected to differentiate the streets.
- Standardize county reports.
- Standardize procedures for adding new features to the spatial layers.
- Create standards for the general appearance of GIS applications.
- Develop installation and distribution procedures.
- Standardize data entry and editing procedures. Data entry procedures will need to be integrated with staff work routines to promote accurate and reliable spatial and attribute data when developing new data sets or updating existing datasets.
- Develop a detailed Quality Assurance/Quality Control (QA/QC) procedure for reviewing the accuracy of the GIS data and its attributes.
- Maintain data in the VBMP standard coordinate system (Virginia State Plane, NAD 83, Survey Feet).
- Create metadata (standard information about GIS data) for each data layer. Metadata tracks the date, origin, coordinate system, and other such information for data layers.

11. Startup Procedures/Steps

A county asset inventory is a very large project. Therefore, careful planning will make the process go more smoothly. There are at least eight steps involved with doing the county asset

inventory and developing a GIS-based county asset inventory system. The steps can be performed in-house or by a consulting team.

The first task is to complete a detailed Needs Assessment. This process gathers information regarding existing operational procedures, hardware and software, existing asset data, and personnel needs. It should include interviews of key individuals representing various county departments to obtain a comprehensive view of the agency's operations, and where GIS might improve them. Basic GIS concepts should be discussed and illustrated to those interviewees that have little prior understanding of GIS. A comprehensive Needs Assessment should then be compiled from the results of the interviews. This document explains the various requirements for an asset inventory system in the following areas: personnel needs, spatial data development needs, application functionality requests, basic system requirements, including preliminary, general hardware and software recommendations, and training needs.

The second task is to develop a functional requirements document for the proposed system. This document should describe, as completely as possible, all of the technology and functionality that is to be included in the county asset inventory system:

- Hardware specifications
- Software purchases
- Detailed descriptions of work-flow, and examples of the graphic user interfaces
- Describe each tool that is part of that graphic user interface, and its functionality
- Describe how data would flow between the different databases and data warehouses, if applicable
- Describe the redundant security measures that will be put in place to make certain of data integrity and confidentiality, when applicable
- Analytical techniques that the application/system provides
- Describe each of the potential products (reports, maps, charts, summary tables) that the user will be able to generate within the system

The third task should be to compile or develop asset spatial data sets that can be used by the asset inventory system. Data development is often the most time consuming and costly part of a project. At this point, the method of data collection (see section 3) pertaining to an asset should be studied and modified as needed. Data development may include collection through fieldwork using GPS, digitizing from hardcopy sources, geocoding, data conversion, integration of other data sources, and acquiring data from external sources.

Next, the system development and test phase can begin. During this time, the application will be developed as it was outlined in the functional requirements phase. The local government agency should require periodic reviews of the application at particular milestones, such as 50% and 75% completion. This will make certain that problems with the application will be recognized early in the development process, and that the local government agency remains a part of the development process throughout the project timeline.

When the system is nearing 100% completion, it should be installed and tested in the environment in which it will ultimately be used. This allows the users to test the system alongside the application developers, and determine any system integration problems that might arise. It also gives the developers the opportunity to test the application's functionality in a real-world situation. This testing process should be as comprehensive as possible. Each process detailed within the functional requirements should be tested and evaluated at this point.

User training commences once the application reaches completion and is fully documented. Different levels of tutorials and system documentation should be developed depending on the hierarchy of users. Time should be spent at this stage of the project with each potential user of the system to make certain that the proper education occurs. Training should be done through lessons that use real-life examples of system application. This strategy greatly enhances users' ability to apply the functionality to their jobs.

The next phase of the project should include a document that describes a future plan for wider system development. This document accomplishes two goals. The future plan gives the local government agency ideas on how the system might grow to assist other facets of its business practices. Secondly, it provides the agency with a ready-made grant proposal for applying for potential funding sources.

The final phase of a successful county asset inventory system is ongoing technical support. The local government agency should always include this contingency within its cost estimates of a project for a minimum of three months after a system has been put into place. No matter how effective an application appears, problems and system changes inevitably impact the functionality of an application.

12. Estimated time line and/or implementation (stand alone) schedule:

Phase	**Duration**
RFP/Contract process (construction, posting, proposal acceptance, review, award of contract)	4 months - 1 year
Needs Assessment	3-5 months
Functional Requirements	6 months
Data Development	6 months – several years
System Development and Testing	7-8 months
Installation and Testing	3 months
User Training	½ month
Plan for Future Development	1 month
Ongoing Support	4 months

13. Best Practice Examples in Virginia

Henrico County
4301 E. Parham Rd
Richmond, VA 23228
(804) 501-5769
www.co.henrico.va.us/devsite/gisstatus.html

Prince William County
4361 Ridgewood Center Drive
Prince William, VA 22192,
703- 792-6666
http://www.co.fairfax.va.us/living/publicworks/default.htm

City of Hampton
Public Works
22 Lincoln Street, 4th Floor
Hampton, VA 23669
757-727-8311
http://www.hampton.va.us/publicworks/engineering_services_gis_services.html